

THE CLASSIFICATION OF BUMBLE-BEE GOBIES (*BRACHYGOBIUS* AND ASSOCIATED GENERA) (TELEOSTEI : GOBIIDAE)

by

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ABSTRACT. - The patterns of head lateral line sensory papillae (free neuromast organs) in Indo-Pacific "bumble-bee" gobies currently placed in *Brachygnathops* suggest that *Hypogymnogobius* Bleeker should be revived for its type species *Gobius xanthozona* Bleeker, 1849, which has numerous transverse rows of head papillae in contrast to the abbreviate pattern seen in the type of *Brachygnathops* (*Gobius doriae* Günther, 1868), and other species. Relationships of the genera are briefly discussed.

RÉSUMÉ. - La disposition des papilles cutanées (organes ciathiformes) de la ligne latérale céphalique chez les gobiidés "bumble-bee" de l'Indo-Pacifique suggère que *Hypogymnogobius* Bleeker devrait être réhabilité pour son espèce-type *Gobius xanthozona* Bleeker, 1849, rangée actuellement dans *Brachygnathops*. Il a de nombreuses rangées transversales de papilles cutanées sur la tête contrairement au nombre réduit trouvé chez le type de *Brachygnathops* (*Gobius doriae* Günther 1868), et d'autres espèces. Les relations du genre sont discutées brièvement.

Key-words : Gobiidae, *Brachygnathops*, *Hypogymnogobius*, I, Indo-Pacific, Head lateral-line.

The gobiid genus *Brachygnathops* Bleeker comprises several small gobiid species inhabiting fresh and brackish waters of the Indo-Australasian region. Since 1905 (Sterba, 1962), *Brachygnathops* species have been among tropical fishes utilised in the aquarium trade, where their vividly contrasting black and yellow banding has earned the English common name of "bumble-bee gobies". Among Gobiini, Bleeker (1874) distinguished a "subphalanx" of *Brachygnathops*, for *Lophogobius* Gill (type *Gobius crista galli* Valenciennes, 1837) and *Brachygnathops* (type-species *Gobius doriae* Günther, 1868). The grouping was characterised by short, oblong body form, depth four times in length, large scales, no canine teeth, short dorsal and anal fin-rays, blunt convex caudal fin, and six first dorsal rays. *Brachygnathops* was defined by the depressed head, wider than high, lack of nape crest, cycloid scales, with about 27 in lateral series, naked nape and breast, separate dorsal fins, and median fin counts of D1 6, D2 8, and A 8. Elsewhere, in the subphalanx *Eugobii*, of slimmer body form, Bleeker introduced *Hypogymnogobius* (type-species *Gobius xanthozona* [sic] Bleeker, 1849), differing essentially in possessing about 50 ctenoid scales in lateral series, and more (10) rays in both second dorsal and anal fins; 4 branchiostegal rays were also noted, as for other adjoining genera. However, Koumans (1953) included *Hypogymnogobius* within *Brachygnathops*, together with *Thaigobiella* Smith (type-species *Thaigobiella sua* Smith). *Thaigobiella* was defined by Smith (1931) with reference to *Vaimosa* Jordan & Seale (now synonymised with *Mugilogobius* Smith), emphasizing a reduced number of second dorsal and anal rays, pluriserial teeth, large scales (LL 26), and scaled opercles, but with the rest of the head naked. The broad black and yellow banding of the type-species was described and illustrated by Smith (1931 : fig. 17), although without special comment other than on its attractiveness. Lumping all these taxa under the senior synonym of *Brachygnathops*, Koumans (1953) recognised merely three species within this genus, regarding *Gobius doriae* and *Thaigobiella sua* as synonyms of *Gobius natus* Hamilton-Buchanan, 1822, but distinguishing *xanthozonus* and *aggregatus* Herre, 1940. In a later revision, Inger (1958) expanded the genus to eight species, separating *natus*, *doriae*, *sua* and *xanthomelas* Herre, 1937 from the *natus* assemblage of Koumans, and describing two new species (*kabiliensis* and *sabanus*), as well as continuing the recognition of *aggregatus* and *xanthozonus*. Since then, there has been no further revisional work published, although affinities of *Brachygnathops* were briefly

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has been no further revisional work published, although affinities of *Brachygobius* were briefly discussed by Miller (1987). Probably on the basis of the distinctive coloration, *Brachygobius* has given the impression of an easily defined and essentially homogeneous taxon.

However, while examining head lateral-line systems of gobioid taxa studied by Koumans (1953), the author found that the types of *Gobius xanthozonus* had a markedly different head sensory papillae pattern to that seen in material identified as *doriae* and other *Brachygobius* species. If apomorphies in the lateral-line system are to be employed as the ultimate criteria in the definition of gobioid genera, it is necessary to resurrect *Hypogymnogobius* as a separate genus for the former species. This genus, and the associated *Brachygobius*, is therefore redefined below. Further consideration of *Thaigobiella*, based on head papillae patterns in Smith's material in the National Museum of Natural History, Washington, does not support separation from *Brachygobius* (see Fig. 3).

MATERIAL AND METHODS

Hypogymnogobius xanthozonus. Indonesia : three females, 25 + d to 35.5 + d mm (RMNH 4541), from Java, Borneo and Sumatra, P. Bleeker (according to RMNH records, the smallest specimen is the holotype of *Gobius xanthozonus* Bleeker, 1849, and the type-locality is Surabaya, Java (Bleeker, 1849)); two females, 19.2 + 5 to 31 + 6.5 mm (RMNH 12082), Surabaya, September 1927 and December 1929, Buitendijk; one female, 26 + 5 mm (RMNH 12083), March 1927, Buitendijk; one female, 31 + 6 mm (RMNH 12084), Osthoek, Java, 1921, Buitendijk; one female, 38 + 7 mm (RMNH 13710), Osthoek, Java, Buitendijk.

Brachygobius doriae. Malaysia : three syntypes (BMNH 1868.1.2.8.17-19), including one male, 24.5 + 6 mm, and two females, 24.5 + d and 25.5 + 6 mm, Sarawak, Doria; Aquarist suppliers : one female, 24 + d mm, and many others, Bristol and Bangkok.

Brachygobius aggregatus. Philippines : six, 12 + 3.3 to 15 + 3 mm (BMNH 1938.12.1.193-8), paratypes, Damaguete, Herre, 1936-37 Oriental Expedition; many, including female, 13 + 3 mm (USNM 258074), 20 km N Dumaguete, 31 March 1976, T. Roberts.

Brachygobius kabiliensis. Malaysia : one female, 13.5 + 2.5 mm (USNM 171753), paratype, Kabili River, Sandakan District, East Coast Residency.

Brachygobius alcocki. India : three syntypes, 10.5 + 2.0 to 11.5 + 2.5 mm (ZMA 114.487), Port Canning, Bengal, N. Annandale.

Brachygobius sabanus. Malaysia : one female, 19.0 + 4.8 mm (USNM 171752), paratype, Kinabatangan River, North Borneo, R. Inger.

Brachygobius sua. Thailand : one, 12.6 + d mm (USNM 119565), July 1930, H. M. Smith; eight, 10 + 3 to 17 + 3 mm (USNM 119566), Bangkok, 10 May 1934, H. M. Smith; one, 9 + d mm (USNM 119567), Bangkok, 16 January 1934; five (USNM 119568), Bangkok, 13 May 1925, H. M. Smith [the holotype is now missing from USNM collections].

Terminology for head lateral-line sensory papillae patterns and meristic counts as Miller (1986; 1987).

GENERIC DEFINITIONS

Hypogymnogobius Bleeker, 1874

Type-species *Gobius xanthozona* Bleeker, 1849 (by original designation).

Body moderately elongate (Fig. 1), subcylindrical anteriorly; eyes small, dorsolateral, with broad interorbital space, less than half interorbital width; cranial roof covered by dorsal axial musculature; caudal fin rounded, not exceeding head length; body with ctenoid scales, each with several or more long ctenii, longest at focus; LL 40-46 (36-46); predorsal area, before

line from upper origin of P to D1 I origin, and head naked, except for opercle mostly covered with scales; breast and abdomen naked; uppermost and lowermost scales at caudal fin origin not enlarged; snout oblique, somewhat longer than eye diameter, convex in section; anterior nostril very short, tubular, downturned at labial groove; posterior nostril pore-like, before eye. D1 VI, D2 and A short, I/8; pectoral girdle without dermal flaps on anterior edge, P 19 (17-19), uppermost rays contained within fin membrane; pelvic disc complete, short, rounded. Mouth oblique, jaws subequal, with posterior angle below anterior half of eye; upper lip not more than two-thirds lateral preorbital width; chin without mental fold or barbels; teeth in jaws caniniform, in 2-3 rows medially; outer row somewhat enlarged, especially laterally; pharyngeal teeth not examined. Tongue convex, not adnate to floor of mouth; branchiostegal membrane attached along at least three-quarters of lateral margin of isthmus. Coloration of broad black and yellow bands (Fig. 1).

Head lateral-line system (Fig. 2) without canals. Sensory papillae with suborbital row *a* of five long transverse rows, each of several papillae, without intervening single papillae; longitudinal row *b* long, from preopercular groove forwards to below anterior part of eye, below last four rows of *a*; series *c* with five transverse rows, most anterior below most anterior row of *a* but not united; interorbit with five transverse rows (*p*), and medial preorbital series *s* includes two short transverse rows, flanked medially by longitudinal *r*. Anterior dorsal row *o* of a single papilla; row *g* well developed; row *n* well to rear of orbit; preoperculo-mandibular series row *e* uniserial; row *i* with many short (2-3 papillae) rows; mental row *f* longitudinal.

Skeleton with vertebral mode (including urostyle) 10 + 15; pterygiophores of first dorsal fin (3) 12210, those of second dorsal and anal fin not doubled between neural and haemal spines; 2-3 pterygiophores before first haemal arch; caudal skeleton with one epural.

One species, *Hypogymnogobius xanthozonus* (Bleeker, 1849) (*Gobius xanthozona* Bleeker, 1849), from Sumatra, Borneo, and Java (Koumans, 1953).

***Brachygobius* Bleeker, 1874**

Type-species *Gobius doriae* Günther, 1868 (by original designation).

Body moderately elongate, subcylindrical anteriorly; eyes moderate, dorsolateral; flattened interorbital space, two-thirds to equal eye diameter; cranial roof covered by dorsal axial musculature; caudal fin rounded, not exceeding head length; body with large ctenoid scales; LL 22-27 (21-28); predorsal area, before line from upper origin of P to D1 I origin, with or without scales; head naked, sometimes opercle with scales; breast and abdomen naked; uppermost and lowermost scales at caudal fin origin not enlarged; snout oblique, about equal or somewhat longer than eye diameter, convex in section; anterior nostril short, tubular, downturned at labial groove; posterior nostril pore-like, before eye. D1 VI, D2 and A short, I/7-9; pectoral girdle without dermal flaps on anterior edge, P 13-17 (12-17), uppermost rays contained within fin membrane; pelvic disc complete, short, rounded. Mouth oblique, jaws subequal, with posterior angle below anterior half of eye; upper lip not more than two-thirds lateral preorbital width, chin without mental fold or barbels; teeth in jaws caniniform, in 2-3 rows medially; outer row somewhat enlarged; pharyngeal teeth caniniform. Tongue convex, not adnate to floor of mouth; branchiostegal membrane attached along lateral margin of isthmus. Coloration of broad black and yellow bands.

Head lateral-line system (Fig. 3) without canals. Sensory papillae with suborbital row *a* of five well-spaced papillae, forwards to below anterior part of eye; longitudinal row *b* short, from preopercular groove forwards to below pupil; series *c* with five papillae, extending rearwards to below anterior end of *b*, with a single papilla above *c* and *b*; interorbit, and medial preorbital series *s*, flanked medially by longitudinal *r*. Anterior dorsal rows *o* and *n* each of a single papilla, row *g* short; preoperculo-mandibular series row *e* and row *i* uniserial.

Skeleton with vertebral mode (including urostyle) 10 + 15; pterygiophores of first dorsal fin (3) 12210, those of second dorsal and anal fin not doubled between neural and haemal spines;



Fig. 1 : *Hypogymnogobius xanthozonus* (Bleeker) ; (A) female, 26 + 5 mm (RMNH 12083), and (B) female, 31 + 6.5 mm (RMNH 12082).

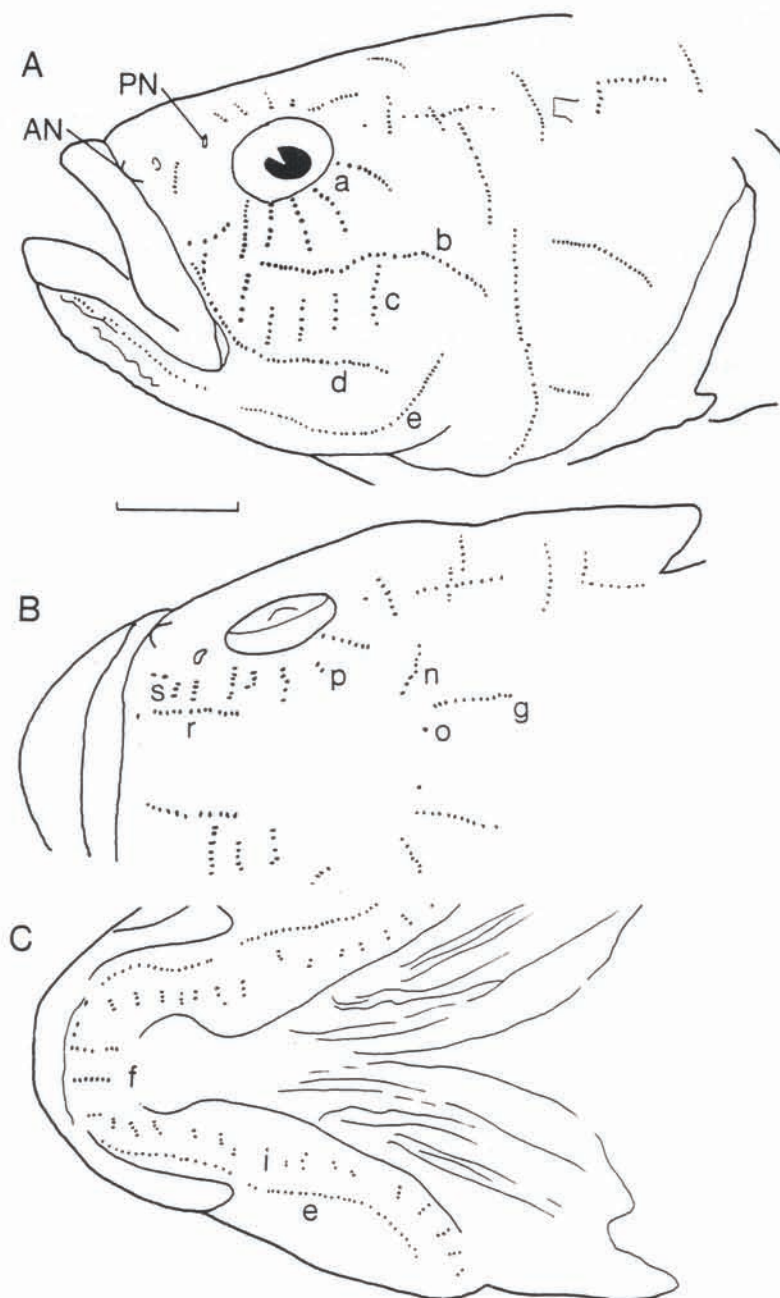


Fig. 2 : *Hypogymnogobius xanthozonus* ; lateral-line sensory papillae of head in syntype, 35.5 + d mm (RMNH 4541, part), in (A) lateral, (B) dorsal, and (C) ventral views. AN, PN, anterior and posterior nostrils ; other abbreviations as text. Scale : 2 mm.

2-3 pterygiophores before first haemal arch ; caudal skeleton with one epural. Vertebral and pterygiophore values agree with those listed for *Brachygobius* by Birdsong *et al.* (1988).

Eight nominal species may now be assigned to *Brachygobius*. Seven of these were recognised by Inger (1958), and the eighth, *Gobius alcocki* Annandale, 1906, is here provisionally distinguished following inspection of type material. This species was attributed to *nunus* by Koumans (1953) but keys out to the *aggregatus* / *kabiliensis* dichotomy of Inger's key. However, in three syntypes, the anal band reaches the ventral midline (as in *aggregatus*), but there are about eleven predorsal scales (none in *aggregatus*, but 7 or 8 in *kabiliensis*). The species of *Brachygobius* are, in chronological order of publication:

Brachygobius nunus (Hamilton, 1822) [*Gobius nunus* Hamilton, 1822 : 54 (India : Ganges below Calcutta)].

Brachygobius doriae (Günther, 1868) [*Gobius doriae* Günther, 1868 : 265, pl. 12 (Sarawak)].

Brachygobius alcocki (Annandale, 1906) [*Gobius alcocki* Annandale, 1906 : 201, fig. 1 (Port Canning, Bengal)].

Brachygobius sua (Smith, 1931) [*Thaigobiella sua* H. M. Smith, 1931 : 35, fig. 17 (Thailand : Bangkok)].

Brachygobius xanthomelas Herre, in Herre & Myers, 1937 [*B. xanthomelas* Herre, 1937 : 43, pl. 4 (Malaysia : Mawai District, Johore)].

(vi) *Brachygobius aggregatus* Herre, 1940 [*B. aggregatus* Herre, 1940 : 361, pl. 4 (Dumaguete, Philippines)].

Brachygobius kabiliensis Inger, 1958 [*B. kabiliensis* Inger, 1958 : 110, fig. 19 (Sabah : Kabili River, Sandakan District)].

Brachygobius sabanus Inger, 1958 [*B. sabanus* Inger, 1958 : 113, fig. 20 (Sabah, Lamag, Kinabatangan District)].

DISCUSSION

The modified head lateral-line system of gobioid fishes, with limited canals and tracts of free neuromast organs (sensory papillae), provides a source of synapomorphic and often autapomorphic patterns which the author believes to be the best criteria for defining gobioid genera to facilitate phylogenetic discussion as well as practical identification of taxa. Employing the nomenclature for basic patterns used by Miller *et al.* (1980), the "transverse" (vertical laterally) papillae rows in the syntypes of Bleeker's *Gobius xanthozona* (Fig. 2) differ markedly from the "abbreviate" papillae patterns seen in the type species, *Gobius doriae*, of *Brachygobius* (Fig. 3a) and the several species now grouped with it (Fig. 3 b-f). In fact, transverse papillae rows are not seen in a range of genera with which *Brachygobius* is believed to share common ancestry (Miller, 1987), but are found in a variety of other gobioid genera (Miller *et al.*, 1980), which are believed to be more distant phylogenetically. However, when compared in detail with these, the pattern in *Hypogymnogobius* is found to differ in underlying arrangement, in keeping with disparity in other morphological features. Thus *Hypogymnogobius* does not show a pattern of three rows above row *b* which can be traced from eleotridines such as *Bostrychus* and *Eleotris* into many gobiine and gobiionelline genera, while the division of anterior cheek rows into upper and lower parts is similarly absent from the latter series (for example, as illustrated by Miller & Wongrat, 1979). Vertical cheek rows in another gobiine, *Drombus*, include the penultimate row as longest (Prince Akihito *et al.*, 1984), a feature not seen in *Hypogymnogobius*, while transverse rows in some of the species assigned to *Acentrogobius* and *Glossogobius* are obviously derived from a simple longitudinal configuration found in otherwise similar forms (Hoesé, 1983). *Hypogymnogobius*, and *Brachygobius*, also differ from all these genera except the gobiionellines in dorsal pterygiophore sequence of 12210 rather than 22111 or 22110 (Miller, 1987 ; Birdsong *et al.*, 1988).

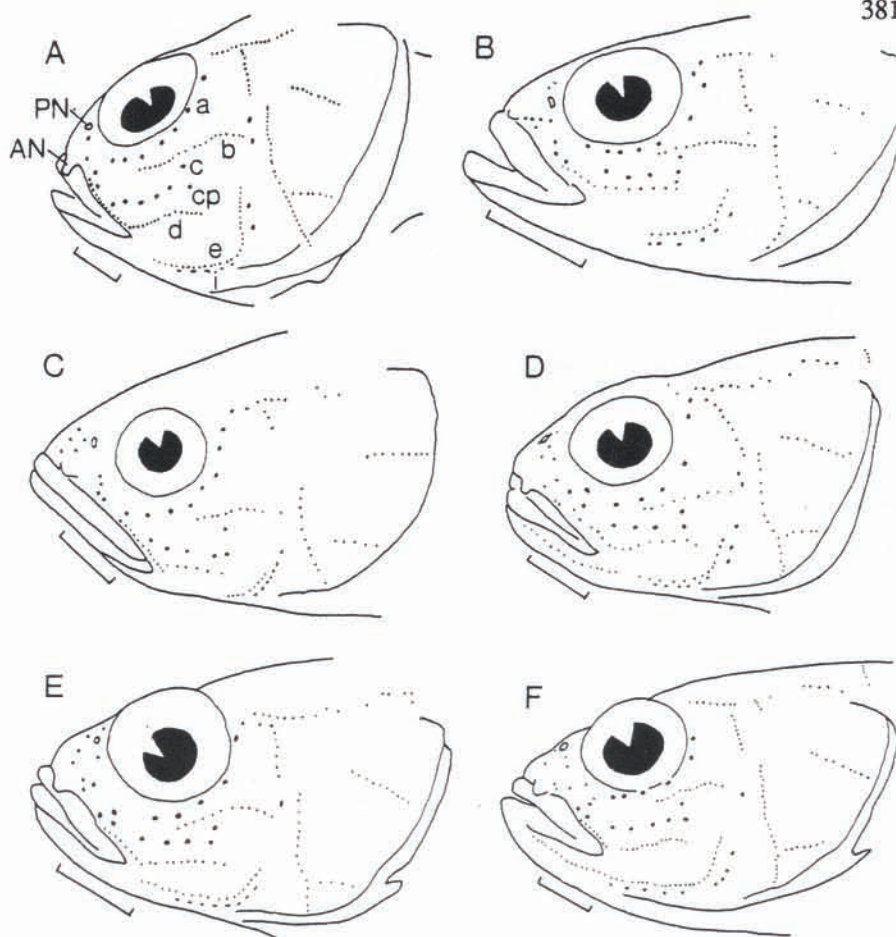


Fig. 3 : *Brachygobius* spp. ; lateral-line sensory papillae of head in (A) *doriae*, syntype, male, 25.4 + 6 mm (BMNH 1868.1.2.8.17-19, part) ; (B) *alcocki*, syntype, 11.5 + 2 mm (ZMA 114.487) ; (C) *sua*, female, 17 + 3 mm (USNM 119566) ; (D) *aggregatus*, female, 13 + 3 mm (USNM 258074) ; (E) *kabiliensis*, female, 13.5 + 2.5 mm (USNM 171753) ; (F) *sabanus*, female, 19 + 4.8 mm (USNM 171752). Abbreviations as Fig. 2. Scale : 1 mm.

In several derived characters, *Hypogymnogobius* resembles *Brachygobius*. Apart from pterygiophore formula, there is also the reduction in vertebral number from 26 to 25 (involving loss of a caudal vertebra), general habitus, distinctive coloration, and loss of head canals. On this basis, it would appear reasonable to suggest that the transverse pattern displayed by *Hypogymnogobius* has evolved independently with separation of this genus from common ancestry with *Brachygobius*. This hypothesis is supported by the general correspondence between number of transverse rows in *Hypogymnogobius* and the number of individual papillae in rows *a* and *c* of the *Brachygobius* species. The relationships of their ancestral stock has been discussed for *Brachygobius* by Miller (1987). Closest common ancestry is with the diminutive species of *Pandaka* and the larger *Hemigobius*, but *Brachygobius* and *Hypogymnogobius* both differ from these genera in the presence of banded coloration and also in the situation of row *b* below the level of the eye, rather than behind the lower border of the orbit as seen in both *Pandaka* and *Hemigobius* (Miller, 1987, fig. 8). In osteology (Miller, 1987), *Brachygobius* differs from more

generalised relatives such as *Mugilogobius* and *Pseudogobius* in the reductive features of narrow metapterygoid and single epural, as well loss of one vertebra (also in *Hypogymnogobius*).

As well as in head papillae patterns, *H. xanthozonus* also differs from *Brachygobius* species in the higher number of scales in lateral series (about 50 and not more than 30 respectively). In coloration (Fig. 1), greatest similarity exists with *B. doriae* and *B. sabanus*, with (i) a single dark band behind the anal fin base, (ii) first trunk band overlapping anterior half of first dorsal origin, (iii) base of first dorsal black anteriorly, (iv) first trunk band beginning from middle of opercle, (v) second dorsal fin with black pigmentation on all rays, and (vi) proximal half of pelvic disc dark.

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REFERENCES

- AKIHITO PRINCE, HAYASHI M. & T. YOSHINO, 1984. - Suborder Gobioidi. In : The Fishes of the Japanese Archipelago (Masuda K., Amaoka C., Araga C., Uyeno T. & Yoshino T., eds), pp 236-289. Tokyo : Tokai University Press.
- BIRDSONG R.S., MURDY E.O. & F. L. PEZOLD, 1988. - A study of the vertebral column and median fin osteology in gobioid fishes with comments on gobioid relationships. *Bull. mar. Sci.*, 42 : 174-214.
- BLEEKER P., 1849. - Bijdrage tot de kennis der Blennioiden en Gobioiden van den Soenda-Molukschen Archipel, met beschrijving van 42 nieuwe soorten. *Verh. Bat. Gen.*, 22 : 1-40.
- BLEEKER P., 1874. - Esquisse d'un système naturel des Gobioides. *Arch. néerl. Sci. Nat.*, 9 : 289-331.
- CUVIER G. & A. VALENCIENNES, 1837. - Histoire Naturelle des Poissons. 12. Paris, F. G. Levrault, 507 pp., pls 344-368.
- GUNTHER A., 1868. - Description of two new gobioid fishes from Sarawak. *Ann. Mag. nat. Hist.* (4), 1 : 264-266.
- HAMILTON-BUCHANAN F., 1822. - An Account of the Fishes found in the River Ganges and its Branches. Edinburgh & London.
- HERRE A. W. C. T., 1940. - Notes on fishes in the zoological museum of Stanford University, VII. New and rare Philippine gobies from the Herre 1936-1937 Oriental Expedition, and the collections of the Bureau of Sciences. *Phil. J. Sci.*, 72 : 357-369.
- HERRE A. W. C. T. & G. S. MYERS, 1937. - A contribution to the ichthyology of the Malay Peninsula. *Bull. Raffles Mus.*, 13 : 5-75.
- HOESE D. F., 1983. - Sensory papillae patterns of the cheek lateralis system in the gobioid fishes *Acentrogobius* and *Glossogobius*, and their significance for the classification of gobioid fishes. *Rec. Aust. Mus.*, 35 : 195-222.
- INGER R. F., 1958. - Notes on fishes of the genus *Brachygobius*. *Fieldiana Zool.*, 39 : 107-117.
- KOUMANS F. P., 1953. - Gobioidae. In : The Fishes of the Indo-Australian Archipelago, (Weber M. & De Beaufort, L. F., eds), 10, 423 pp.
- MILLER P. J., 1986. - Gobiidae. In : Fishes of the North-eastern Atlantic and the Mediterranean, (Whitehead P. J., Bauchot M.-L., Hureau J.-C., Nielsen J. & E. Tortonese, eds), 3 : 1019-1085. Paris : UNESCO.
- MILLER P. J., 1987. - Affinities, origin and adaptive features of the Australian Desert Goby, *Chlamydogobius eremius* (Zietz, 1896) (Teleostei : Gobiidae). *J. nat. Hist.*, 21 : 687-705.
- MILLER P. J., EL-TAWIL M. Y., THORPE R. S. C. WEBB, 1980. - Haemoglobins and the systematic problems set by gobioid fishes. In : Chemosystematics : Principles and Practice, (Bisby F. A., Vaughan, J. G. & Wright C. A., eds), pp. 195-233. London : Academic Press.
- MILLER P. J. & P. WONGRAT, 1979. - A new goby (Teleostei : Gobiidae) from the South China Sea and its significance for gobioid classification. *Zool. J. Linn. Soc.*, 67 : 239-257.

- SMITH H. M., 1931. - Descriptions of new genera and species of Siamese fishes. *Proc. U. S. nat. Mus.*, 79 (7) : 1-48.
- STERBA G., 1962. - Freshwater Fishes of the World. London : Vista Books., 878 pp., 1193 figs.

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